OBSERVATIONS AT HONOLULU.

Through the kind cooperation of Mr. Curtis J. Lyons, Meteorologist to the Government Survey, the monthly report of meteorological conditions at Honolulu is now made nearly in accordance with the new form, No. 1040, and the arrangement of the columns, therefore, differs from those previously published.

Meteorological observations at Honolulu, June, 1899.

The station is at 21° 18′ N., 157° 50′ W.
Pressure is corrected for temperature and reduced to sea level, and the gravity correction, −0.06, has been applied.
The average direction and force of the wind and the average cloudiness for the whole day are given unless they have varied more than usual, in which case the extremes are given. The scale of wind force is 0 to 12, or Beaufort scale. Two directions of wind, or values of wind force or amounts of cloudiness, connected by a dash, indicate change from one to the other.
The rainfall for twenty-four hours has always been measured at 7:30 p. m., not 1 p. m., Greenwich time, on the respective dates.
The rain gauge, 8 inches in diameter, is 1 foot above ground. Thermometer, 9 feet above ground. Ground is 43 feet, and the barometer 50 feet above sea level.

Date.	Pressure at sea level.	Temperature.		During twenty-four hours preceding 1 p. m., Greenwich time, or 2:30 a. m., Honolulu time.							Sea-level pressures.		Total rainfall at 9 a. m., local time.
				Temperature.		Means.		Wind.		Average cloudiness.			
		Dry bulb.	Wet bulb.	Maximum.	Minimum.	Dew-point.	Relative humidity.	Prevailing direction.	Force.		Maximum.	Minimum.	
	*	†	†			‡	‡		§				
1	30.02	71	67	81	72	62.5	64	ene.,nne	5-3	3	30.11	30.01	0.04
2	30.00	73	67.5	81	71	64.7	73	ne.	4-2	4	30.08	29.98	0.03
3	30.03	72	65.5	82	70	64.5	68	ne.	3	3	30.06	29.99	0.00
4	30.01	73	67	82	72	64.3	66	ne.	3-4	3-6	30.08	30.01	0.00
5	30.00	73	67.5	84	72	64.0	65	ne.	3	3-6	30.08	29.99	0.01
6	30.00	73	67	84	73	63.7	64	ene.	3-1	6-2-7	30.03	29.98	0.00
7	29.99	68	66.5	82	70	63.5	64	nne.	3-0	2-8	30.04	29.94	0.01
8	30.01	73	65	82	68	63.0	71	ne.	3-0	3-8	30.05	29.97	0.00
9	30.03	72	66	82	72	61.0	60	ne.	4	4	30.07	30.02	0.04
01	30.00	71	66	82	70	62.5	64	nne.	4	3	30.08	30.00	0.05
11	30.00	71	68	81	70	63.0	68	ne.	4	3	30.04	29.96	0.06
12	30.01	72	65.5	82	69	63.0	63	ne.	4	3-1	30.04	29.97	0.04
13	30.00	71	66.5	81	70	63.7	68	ne.	4	3-7	30.05	29.99	0.05
14	30.03	71	64.5	83	69	63.0	67	nne.	3	3	30.08	30.00	0.00
15	30.04	72	65	84	71	60.3	60	nne.	2	2-4	30.08	30.00	0.00
16	30.04	73	64	82	70	61.5	63	ne.	3	3	30.07	30.01	0.00
17	30.00	72	66	81	72	60.7	60	ne-nne.	3-5	5	30.07	29.99	0.03
18	30.01	72	66.5	81	69	62.7	65	ne.	4	2-4	30.05	30.00	0.04
19	30.04	71	66	84	70	63.3	65	ne.	3	4	30.07	30.02	0.11
20	30.03	72	65.5	82	69	62.5	65	nne.	4	4	30.09	30.01	0.02
21	29.98	72	64.5	82	70	62.0	63	ne-nne.	3	1	30.09	29.98	0.00
22	29.99	70	67	83	72	62.0	63	ne.	3-5	2-6	30.05	29.98	0.20
23	30.00	74	66.5	82	69	64.3	71	ne.	3-5	8-3	30.03	29.98	0.11
24	30.02	74	66	82	72	62.7	63	ene.	5	3-8	30.06	29.98	0.09
25	30.01	72	68	83	70	63.3	64	ne.	4	4	30.07	29.99	0.03
26	29.98	72	68	83	72	65.5	73	ne.	3	3-8	30.06	29.98	0.11
27	29.96	73	66.5	81	70	66.0	72	ene.	3	4	30.01	29.93	0.01
28	29.95	73	65.5	83	71	63.0	63	ne.	3	1	30.01	29.94	0.00
29	29.97	73	67.5	83	73	61.5	60	ne.	3	3	30.03	29.97	0.02
30	29.95	70	65.5	83	70	64.5	67	ne.	3	2	30.02	29.94	0.04
Sums.	.....	.....	.....	... .	.....	.....	.....	.....	.....	.....	.....	.....	1.14
Means.	30.003	72.0	66.3	82.3	70.6	63.1	65.4	.....	.....	3-8	30.058	29.983	.....
Departure.	+0.008	.....	.....	.....	.....	−2.2	−5.0	.....	.....	−0.2	.....	.....	−0.40

Mean temperature for June, 1899 (6+2+9)÷3=75.3°; normal is 76.1°. Mean pressure for June (9+3)÷2 is 30.021; normal is 30.013.
*This pressure is as recorded at 1 p. m., Greenwich time. †These temperatures are observed at 6 a. m., local, or 4:30 p. m., Greenwich time. ‡These values are the means of (6+9+2+9)÷4. §Beaufort scale.

SOME PHYSICAL FEATURES AND FLOOD CONDITIONS OF THE JAMES RIVER VALLEY.[1]

By EDWARD A. EVANS, Section Director, Richmond, Va.

The sources of the James River have their rise in the elevated valleys of the central Appalachian range, about 1,800 feet above sea level. Descending rapidly and flowing in a generally easterly direction, the stream crosses the valley of Virginia through Botetourt County and forces its passage through the Blue Ridge at Balcony Falls, in the extreme southeast corner of Rockbridge County, at an elevation of about 700 feet above sea level, or about twice the elevation of the Potomac River at the point where it breaks through the same barrier.

Entering the Piedmont district, it continues its easterly direction until it reaches the middle counties proper, when it swings abruptly to the northeast, which course it pursues until near the thirty-eighth parallel of latitude, when it again resumes its generally eastward trend, entering tidewater at the foot of the falls at Richmond.

Its main tributaries are the Jackson, Cowpasture, Craig, and North rivers in the Appalachian and valley division, the Pedlar, Tye, and Rockfish rivers in the Piedmont division, and the Slate, Willis, and Rivanna rivers in the middle division. There are also several large tributaries flowing in below Richmond, but they are not material for the purpose of this article, which is intended simply to set forth briefly some facts concerning the area and soil conditions of the James basin, and the movement of flood waves from its headwaters to the head of tidewater at Richmond, or what may be considered as the flood district.

It is interesting to note, as showing the physical characteristics of this great watershed, that nearly all of the rivers entering the James come in from the north, where the slope from the crest of the basin to the river level is gradual, and the area large. On the south side it is mostly abrupt and contracted, draining, as a rule, a narrow strip of land contiguous to the main stream. A striking illustration of this feature may be found in Campbell County, where the Falling River, which rises only some 5 miles from the James, flows southward into the Roanoke.[2]

A portion of the country immediately adjacent to the south bank of the James is, therefore, the northern limit of the watershed of all the Virginia rivers which pass out of the State into North Carolina.

The counties and parts of counties comprising that portion of the James basin which is under consideration, are twenty in number, extending from the Alleghanies to the extreme eastern portion of the middle division, inclusive, a majority of which lie on the north side of the river. Their area, roughly, is about 4,390,000 acres.

A brief description of their topography and soil characteristics may be admissible here, as germane to the subject to the extent that a steep land gradient and a hard, compacted, or loose, porous condition of the soil, affords some indication of the probable amount of water which will reach the draining stream under various conditions of precipitation.

In the Appalachian counties are found all the surroundings favorable to rapid drainage. The face of the country is rugged and mountainous, with steep descents from mountain top to valley. The soil is loose and porous; shallow, except in the valleys, and rests upon the solid rock, and hence all moisture in excess of that required to wet it may be expected to quickly reach its outlet. The dip of the basin is mostly eastward.

In the valley counties of the basin, the contour of the land becomes generally undulating, with occasional spurs or headlands of the Alleghenies and Blue Ridge projecting into it. The fall of the land is generally east and south over the northern basin, and east and north in the southern basin. The prevailing soil is a clay loam of great natural fertility. It lacks the looseness and porosity of the Appalachian soils, and sheds a larger percentage of moisture, especially during

[1] The following is a selection of paragraphs from a paper under the above title, published in the Annual Summary for 1898 of the Virginia Section of the Climate and Crop Service. The general treatment of the subject by Mr. Evans seems to the Editor to offer an excellent model for similar work on other river basins. We have omitted only the large hydrographs of the James River for the year 1898 at Richmond and Lynchburg. The elevations of the zeros of the gages are, respectively, 2.8 and 499 feet above mean sea level. The danger lines are, respectively, 12 and 18 feet above the zeros. Therefore, that portion of the river below Richmond is essentially an arm of the sea.—ED.

[2] Since this article first appeared I have been informed by Mr. Murrell, voluntary observer, at Coleman's Falls, Bedford County, that on his farm the divide approaches to within a mile or a mile and a half of the river. The upheaved rock takes a course parallel with the river for a distance of 50 miles or more.—E. A. E.

periods of heavy precipitation and over lands dipping steeply to the stream bed. The influence of the sharp, sudden thunderstorms of summer is immediately apparent in the neighboring streams, the surface, like all clays, shedding water freely when it becomes wet.

This region is subject to heavy thunderstorms and also large monthly amounts of precipitation during spring and fall, and in considering its outflow as aiding to produce freshet water in the James, it is important not to lose sight of these facts.

Primarily, of course, the amount of precipitation deposited must be the main point as a basis for calculation. But previous or attendant circumstances, or features, should also receive their proper share of attention, as, for example: prior condition of the soil in respect to dryness or moisture, its ability to absorb or shed moisture, depth to subsoil, character of subsoil, and *rate* of precipitation. These Appalachian and valley counties may be called the upper drainage basin of the James.

Proceeding to the watershed of the Piedmont and middle counties, we find the land rolling and very hilly, particularly on the lower slopes of the Blue Ridge, and falling gradually eastward to the tidewater division. The crest of the Blue Ridge is, geologically, the oldest land in the State, being the first to appear above the waters, and in its higher valleys originate most of the various streams which unite to drain this portion of the basin. In the Piedmont and parts of the middle counties basin is found a soil commonly known as "the red lands." Generally, the soil is fertile, and the exposed decomposing rock, in many localities, furnishes fertilizing ingredients, such as soda and lime, which, carried into the streams by washing rains, is deposited in the "bottom" lands, making them exceptionally rich and productive.

In 1607, Captain John Smith, speaking of tidewater Virginia, said: "The vesture of the earth in most places doth manifestly prove the soyle to be lusty and very rich." Had he applied this observation to these bottom lands, it would have been equally appropriate.

The area comprised in this portion of the James watershed is larger than that of either the valley or Appalachian, and, owing to the rolling character of the country, an excess of moisture does not require much time to reach an outlet. The soil is mostly lighter and more porous than that of the valley basin.

The main feeder of the James is the Rivanna River, which drains a region of large annual precipitation; it is subject to sudden rises to freshet height, which, entering the James at Columbia, make high water at Richmond generally within twelve hours.

This is usually a late spring, summer, or early fall condition, when thunderstorms are prevalent, and rises from this source, both large and small, may be easily traced on the hydrograph. A combination, with rises, coming down from the upper watershed, will produce the highest gage reading recorded at the Richmond station.

It constitutes a source of immediate and pressing danger to the business interests of Richmond, whenever sufficient precipitation occurs over its basin to cause 15 or more feet at Columbia, while for 19 feet flood warnings are issued.

Among the many features of interest connected with high water in the James, may be mentioned one which has an important bearing in estimating flood heights on the lower courses of the stream, viz, the flattening of the crest. From careful examination of the gage records at Lynchburg and Richmond, it is found that rises resulting from precipitation over the upper watershed (Appalachian and valley basins) will diminish in height from 1 to 2 feet on stages of 5 feet or less, and from 2 to 3 feet on stages between 5 and 12 feet. For the middle watershed (Piedmont and middle counties basin) flood water coming out of the Rivanna River shows, in a still more marked degree, this crest flattening. No daily gage readings for Columbia are available, so that the difference on moderate stages can not be determined; but for flood stages sufficient data are at hand to accurately estimate it. Comparison of Columbia stages of 19 feet, or more, with Richmond readings of the same flood wave, show a diminution in the vertical height of from 9 to 12 feet. But the Columbia gage readings are, in a sense, abnormal, and strictly local, and by no means indicate the general height of the river. The Rivanna here enters the James at nearly right angles, and at a point where the latter river is narrow, and it results, therefore, that freshet water coming from this source is banked up against the south shore of the James, producing a congested condition, during which it attains a local height greatly in excess of that at points either above or below, before it is carried away. Therefore, much of the flattening of flood crests between Columbia and Richmond may be ascribed to this cause.

In what are generally known as "Rivanna freshets," from 50 to 60 per cent of the height at Columbia will reach Richmond. Combined with flood water from the upper basin, the percentage increases from 60 to sometimes as high as 70.

The rate of flood travel is another highly important consideration. It varies with the amount of precipitation and watershed over which it is deposited. For that portion of the river above, or west of, Lynchburg, the information available is too meager to enable a satisfactory result to be arrived at, but from Lynchburg east to Richmond, the Weather Bureau readings will serve to show the time required for flood travel between the two points.

The river chart for 1898, represents, practically, an average year of water fluctuation and travel. It differs little in extremes or midstages from other years, not exceptional, and may therefore be used to determine the daily march, or progress, of a curve of high water. Summarizing the various rises shown thereon, it is found that upper river water will require from two to three days to pass from Lynchburg to tidewater, the difference in time depending on the volume carried; if accelerated by an influx from the Rivanna and other middle basin feeders, one and a half days are required.

Rivanna basin water, from Columbia to Richmond, moves down in from twelve to eighteen hours, the latter time being for moderate stages.

In the foregoing, the term "upper watershed" has been considered as applying to the Appalachian and valley counties drainage area, and "upper waters" as that portion of the stream contained in this watershed, while the middle watershed refers to the basin lying between the Blue Ridge and head of tide. Rivanna water belongs to this district, but is used distinctively on account of its preponderating influence in producing floods.

RECORDS BY THE KITE CORPS AT BAYONNE, N. J.

By H. L. ALLEN, Bayonne, N. J. (dated July 28, 1899).

The following table, showing the results of thermometer observations at Bayonne, is in continuation of that published on page 11 of the MONTHLY WEATHER REVIEW for January, and is communicated by Mr. Henry L. Allen, on behalf of his colleagues of the Bayonne kite corps. The star in the fifth column indicates those cases in which piano wire was used. As nothing is said to the contrary, it is to be assumed that the temperatures at or just below the kite are as recorded by a Six thermometer and that the maximum temperatures, therefore, in general, refer to some layer of air near the ground, while the minimum temperatures refer to the highest altitude attained. The records for New York City refer to the Weather Bureau station, whose thermometer is 313 feet above the ground and 350 feet above sea level, and have been supplied by the Records Division from the self-registers kept at the New York station.